OHMART

FiberFlex™ with frequency output

Model
LFXG-F
Continuous Level Applications

version 1.0

Manual part number 241089

US & Foreign Patents Pending

Revision history

Manual version	Revision description
1.0	Initial release

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ISO 9001 approval by Lloyd's Register Quality Assurance Limited, to the following Quality Management System Standards: ISO 9001:1994, EN ISO 9001:1994, ANSI/ASQC Q9001-1994. Approval Certificate No. 107563

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Manual part number 241089

April, 2000
Manual version: 1.0

WARNING
This equipment is only to be used in the manner described in this manual. If the equipment is not used per Ohmart/VEGA specifications, the unit is not CE compliant, and may be damaged or cause personal injury.

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Explanation of symbols

The following symbols are used in this manual or on the instrument:

Radiation notice

In the manual, information concerning radioactive materials or radiation safety information is found in the accompanying text.

Caution

In the manual, warnings concerning potential damage to the equipment or bodily harm are found in the accompanying text.

AC current or voltage

On the instrument, a terminal to which or from an alternating (sine wave) current or voltage may be applied or supplied.

DC current or voltage

On the instrument, a terminal to which or from which a direct current voltage may be applied or supplied.

Potentially hazardous voltages

On the instrument, a terminal on which potentially hazardous voltages exist.

User's comments

Ohmart values your opinion! Please fill out this page so that we can continually improve our technical documentation.

Manual: FiberFlex with Frequency Output User Manual v 1.0
Date: _____

Customer Order Number: _____

How we can contact you (optional if you prefer to remain anonymous):

Name: _____

Title: _____

Company: _____

Address: _____

_____

_____

Did you find errors in this manual? If so, specify the error and page number.

Did you find this manual understandable, usable, and well organized? Please make suggestions for improvement.

Was information you needed or would find helpful not in this manual? Please specify.

Please send this page to:

Ohmart Corporation
Director of Engineering
4241 Allendorf Drive
Cincinnati, OH 45209-1599

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Chapter 1
Introduction

Nuclear materials notice

This equipment contains radioactive source material, which emits gamma radiation, a form of high-energy electromagnetic radiation. Only persons specifically licensed by the U.S. NRC (or other regulating body) may install, dismantle, relocate, maintain, repair and test the sourceholder portion of the equipment.

Ohmart Field Service engineers are specifically licensed to install and "commission" nuclear gauges, and can instruct you in the safe operation of your level gauge. To contact Ohmart Field Service, call 513-272-0131. Users outside the U.S. and Canada may contact their local representative for parts and service.

Note
Special instructions concerning your source holder are found in an envelope that was shipped with the source holder and in the special information pocket in the back of this manual. Please refer to this document for radiation safety information

Unpacking the equipment

CAUTION!
Before unpacking the equipment, make sure you are familiar with radiation safety practices in accordance with your U.S. Agreement State, U.S. NRC, or your country's applicable regulations.

Unpack the unit in a clean, dry area. Inspect the shipment for completeness, by checking against the packing slip, and for damage during shipment or storage. If the detector is included as a separate package in the shipment, inspect the assembly for damage that may have occurred during shipment or storage.

If the unit was damaged during shipment, file a claim against the carrier, reporting the damage in detail. Any claim on The Ohmart

Corporation for shortages, errors in shipment, etc., must be made within 30 days of receipt of the shipment.

If you need to return the equipment, see the section "Returning equipment for repair to Ohmart" in the Diagnostics and repair chapter.

When the equipment is unpacked, inspect each source holder included in the shipment to assure that the operating handle is in the OFF position. In the event the handle is found to be in the ON position, place it in the OFF position immediately and secure it.

Note
Most source holder models accept a lock. If the source holder does accept a lock and there is no lock on it, the lock is not secured, you are unable to secure the lock, or the operating handle will not properly move into the off position, call Ohmart Field Service immediately for further instructions 513-272-0131.

Storing the equipment

Storing the source holder - If it is necessary to store the source holder, do so in a clean, dry area. Be sure the source holder shutter is in the OFF or CLOSED position. Check with the current local regulations (U.S. NRC, Agreement State, or other) to determine if the area needs to be restricted in any way.

Storing the detector - Avoid storage at temperatures below freezing. Storage of the detector should be indoors in a temperature controlled area between 50º and 95º F (10º and 35º C) and less than 50% relative humidity. Equipment must be stored in dry conditions until installation. Do not store outdoors.

FiberFlex™ model LXFG-F specifications

System Accuracy	±1% of span typical	Accuracy depends on specific application parameters
Active Lengths	Flexible detector	6″ to 276″(153mm to 7010mm) in 12″ (153mm) increments
Typical Sources	Cesium-137	0.66MeV gamma radiation emitter, 30.2 year half life
	Cobalt-60	1.2 and 1.3 MeV gamma radiation emitter, 5.3 year half life
Power Requirements*	AC	90 to 270VAC at 50 to 60Hz, at 15VA maximum power consumption (25 VA max with heater) CE compliance requires 100 to 230 ±10% VAC
	DC	20 to 60VDC (less than 100mV, 1 to 1000Hz ripple) at 15VA CE compliance requires 24VDC
Signal Cable	Maximum length	3280ft (1000 m)
Flexible Detector	Material	Organic scintillator fibers encased in galvanized steel flexible conduit covered by Santoprene® thermoplastic rubber
	Bend radius	1 foot (305 mm) minimum
	Diameter	1-3/4″ (44 mm)
	Mounting	Angle bracket (standard) 2″ conduit mount (detector inside conduit) optional
GEN2000™ Electronics Housing	4-wire hookup with DC	18-22 AWG (0.82-0.33 mm^2) four conductor shielded
	Certification to CSA and UL standards	•Designed to meet National Electric Code (U.S. & Canada) •Class I, Groups B, C & D, Div 1 & 2 for 115 VAC (220 VAC pending) •Class I, Group A pending for 115 VAC and 220 VAC •Class II, Groups E, F & G, Div 1 & 2 for 115 VAC (220 VAC pending)
	CENELEC certification	EExd IIC T5 (pending)
	Enclosure rating	NEMA 4X IP-66
	Ambient temperature	-4°F to 140°F (-20°C to 60°C), option for lower temperatures available
	Humidity	0-95%, noncondensing
	Vibration	Tested to IEC 68-2-6, IEC 68-2-27 and IEC 68-2-36
	Material	Cast aluminum ASTM A 357
	Paint	Epoxy Powder Coat
Weight	Housing and flexible detector	12 lb + 1 lb × active length in feet 5.44 kg + 1.49 kg × active length in meters
Diagnostics	LED indication	+5V, Memory Corruption, CPU Active, High Voltage

* Power specifications change to 115 VAC or 220 VAC if an internal heater kit is used. For more information, see page 45.

Typical applications

Ohmart level gauges accurately indicate the level of liquids or bulk materials throughout a range on vessels, reactors or tanks.

In order to achieve a level indication over the desired length, it may be necessary to use more than one detector. The manner in which these multiple detectors are linked together depends upon the types of detectors used. Specific details on using multiple detectors are given in Appendix I – Special applications.

A wide range of industry operations profit from the accuracy of quality control systems using Ohmart nuclear level gauges. A level gauge may be used in a number of applications such as the following:

Pulp and Paper

- Liquors
- Bleach plant chemicals
- Coating chemical storage
- Lime mud
- Wastewater treatment tanks

Chemical

- Low pressure/low vapor chemical storage
- Settlers
- Surge tanks

Food and beverage

- Food slurries
- Pastes
- Syrups
- Dough level
- Intermediate batch storage

Water / wastewater

- Settling/aeration tanks
- Clarifiers
- Sludge holding tanks
- Wet wells

Where to find help

If you need help finding information, check the Index and Table of Contents within this manual.

Ohmart Customer Service

Ohmart Customer Service has Field Service Engineers located across the U.S. for on-site service to U.S. and Canada. In many cases, a Field Service Engineer will be at your plant for the start up of your gauge. In addition, Field Service Engineers regularly assist customers over the telephone. If you have a question or need help, call Customer Service during office hours. If your problem is an emergency (for example, line shut down because of Ohmart equipment), you can reach us 24-hours a day.

Ohmart Phone	513-272-0131
Ohmart FAX	513-272-0133
Ohmart Field Service E-mail	Fieldservice@ohmart.com

Ohmart also can provide field service for customers outside the U.S. and Canada. In addition, customers outside the U.S. and Canada may contact their local Ohmart representative for parts and service.

When calling with a question, if possible, please have the following information ready:

- Ohmart Customer Order (C.O.) Number - located on the engraved label on the source holder
- Sensor serial number located on the sensor housing inside the external housing

Principles of operation

Ohmart's nuclear level gauges direct a narrow beam of radiation through the vessel to a radiation detector. The beam is collimated (shaped) so that the entire active length of the detector is exposed to a radiation field.

The material in the vessel blocks the radiation in proportion to its level; the higher level, the more radiation gets blocked and the less is sensed by the detector. The material in the vessel essentially acts as a shield, preventing a portion of the detector from being exposed to the radiation field. The gauge is calibrated to associate the detector readings called counts with the level of the material in the desired engineering units. The output of the detector is a 0-100 kHz true digital frequency output, in proportion to the level of the process.

System overview

The level measurement system consists of three main components:

- source holder
- FiberFlex™ LFXG-F detector
- Smart Pro or Pro Pac Electronics

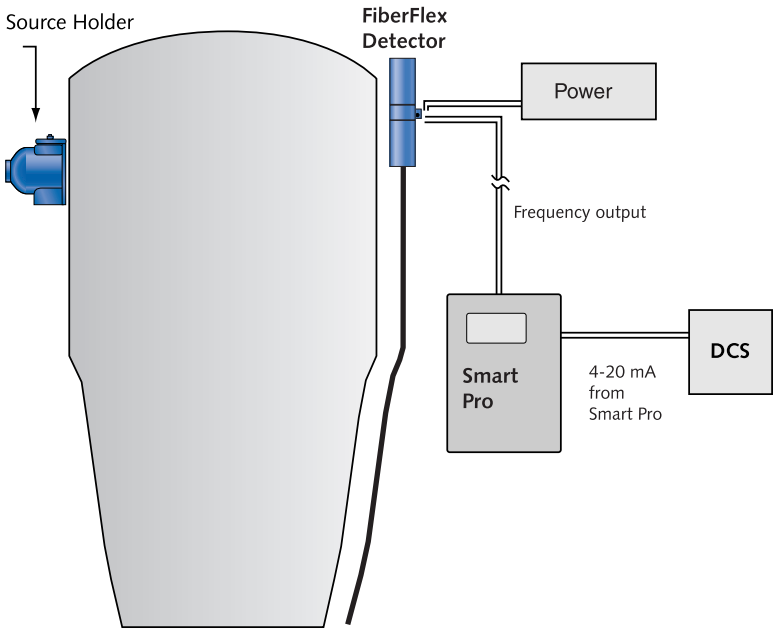


Figure 1: System overview

The source holder is a cast or welded steel device used to house a radiation-emitting source capsule. The source holder directs the

radiation in a narrow collimated beam through the process pipe or vessel; it shields the radiation elsewhere.

The source holder model chosen for each particular system depends on the source capsule enclosed and the radiation specifications required. A shutter on the source holder is used to either completely shield the radiation ("source off") or allow it to pass through the process ("source on").

The FiberFlex™ level detector assembly is mounted opposite the source holder. Inside the FiberFlex™ flexible detector is a scintillation material that produces light when exposed to radiation in proportion to the intensity of the radiation. A photomultiplier tube detects the scintillator's light and converts them into voltage pulses, which are amplified, conditioned and sent to the microprocessor. The microprocessor and associated electronics convert the pulses into a frequency output, proportional to the amount of radiation striking the detector.

Notes

Chapter 2
Installation

Location considerations

When the Ohmart level detector was ordered, the source was "sized" for the optimal performance. If the gauge is to be located other than as ordered, notify Ohmart prior to installation. Proper location of the level gauge can sometimes mean the difference between satisfactory and unsatisfactory operation.

Note
Try to locate the source holder in such a place that it will not become coated with process material, to ensure the continuing proper operation of the source ON/OFF mechanism. Many regulatory agencies (for example, the U.S. NRC) require periodic testing of the ON/OFF mechanism. Refer to the Radiation Safety section that was shipped with the source holder and the appropriate current regulations for details.

Stable temperature

Mount on a portion of the line where the temperature of the process material is relatively stable. Process temperature changes may affect the gauge indication. The amount of the effect depends upon the sensitivity of the gauge and the temperature coefficient of the process material.

Protect insulation

If insulation is between the measuring assembly and the process, protect the insulation from liquids. The absorption of a liquid, such as water, could affect the gauge indication because it blocks some radiation.

Avoid internal obstructions

The best possible installation of a nuclear level gauge is on a vessel that has no internal obstructions (agitator, baffle, manways) directly in the path of the radiation beam. If one of these obstructions is

present, it can shield the radiation from the detector, causing an erroneous reading. If the vessel has a central agitator, the source holder and detector can be mounted on the vessel on an arc other than a diameter, so that the beam of radiation does not cross the agitator. Similarly, other obstructions can be avoided.

Avoid external obstructions

Any material in the path of the radiation can affect the measurement. Some of these, like the tank wall, liners and insulation that are present when the gauge is initially calibrated pose no difficulty, since their effect is accounted for in the calibration. However, when the materials change or new ones are introduced, the gauge reading can be erroneous. For example, insulation that is added after calibration will absorb the radiation and cause the gauge to erroneously read upscale. Slowly changing tank conditions due to material build up are compensated for with regular standardizations. (See the calibration chapter for information on standardization.)

Avoid source cross-talk

When multiple adjacent pipes or vessels are equipped with nuclear gauges, orientation of the source beams must be considered so that each detector senses radiation only from its appropriate source. The best orientation is for the source holders to be on the inside, with radiation beams pointing away from each other.

Mounting the detector

There are two types of mounting options. The first type is the bracket mount. The L bracket supports the electronics housing. For this type of mounting, the conduit clamps should be spaced every 24 inches.

The second type of mounting is the conduit mount. This type of mount consists of an adapter with a 2" conduit coupler. It provides an air hose fitting for applications that need to cool the detector. The conduit mount requires a user-supplied nipple and conduit adapter (union). Shown below are the two mounting types.

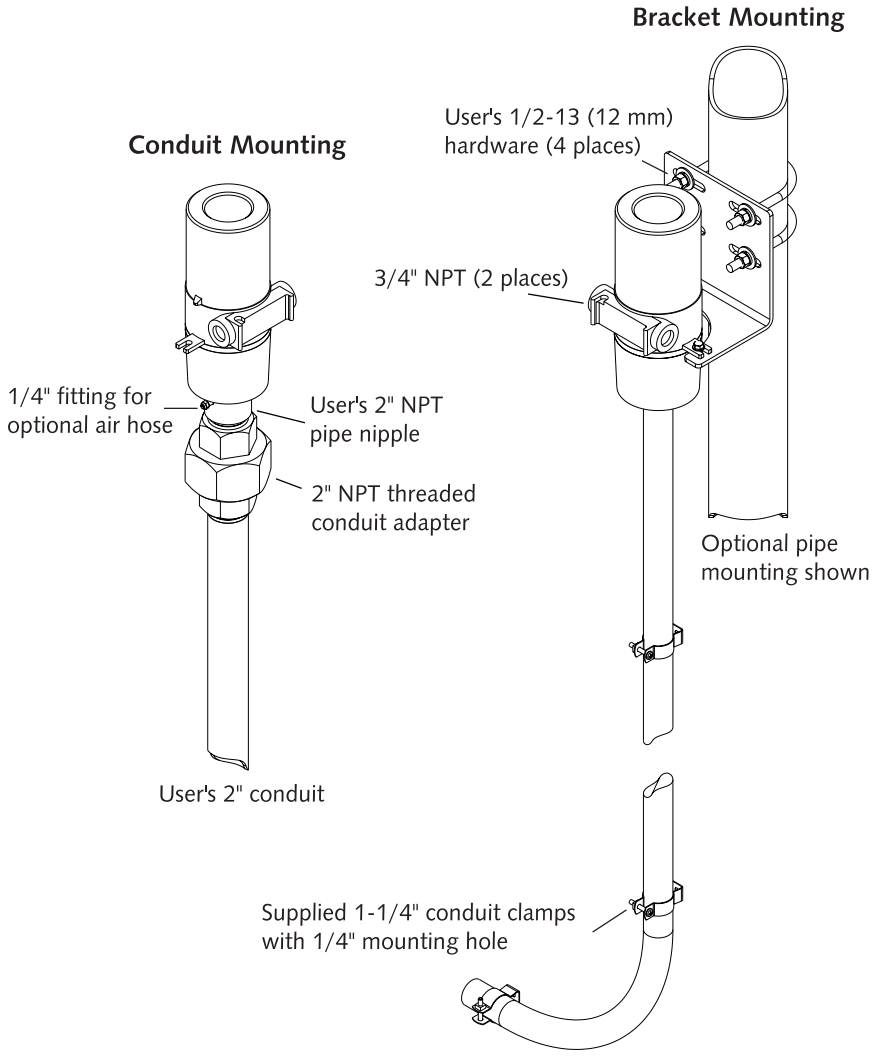


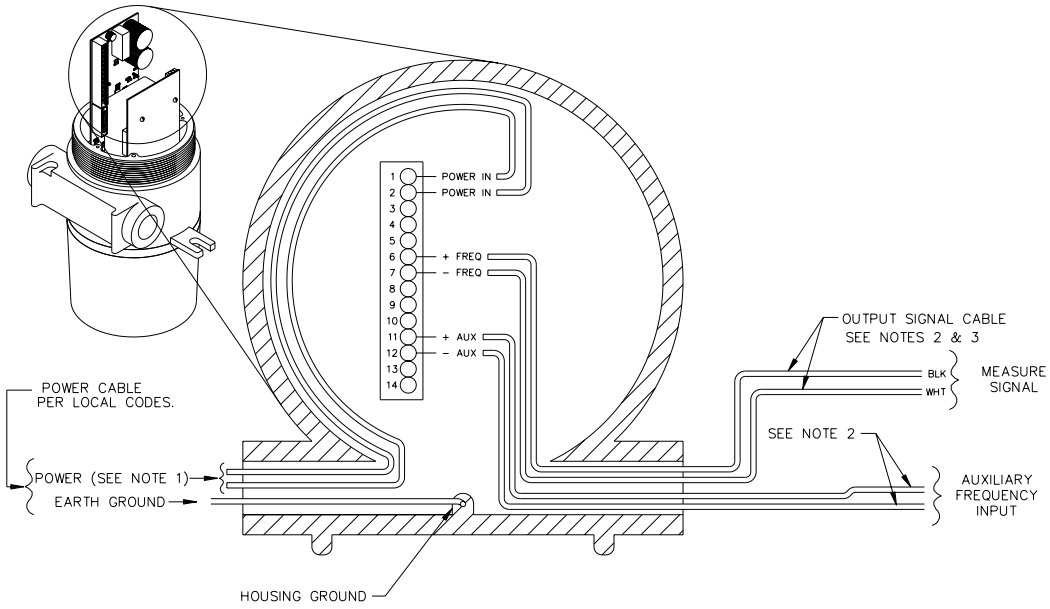
Figure 2: Conduit and bracket mounting

Note
The active area (where it is possible to make a level measurement) is between the bottom of the housing and the end of the flexible conduit. Mount the detector so that this area spans the desired measurement length.

Wiring the equipment

Note
You may have received an interconnect drawing from Ohmart or the engineering contractor. If the instructions on the drawing differ from the instructions in this manual, use the drawing. It may contain special instructions specific to your order.

Follow the drawing notes and the steps which follow for making the input and output connections. Connections are made at the removable terminal strips mounted on the CPU board, which is accessed by removing the explosion proof housing cap.



NOTES:

1) AC VOLTAGE INPUT IS 115 VAC ±10% AT 50 TO 60 Hz, AT 15 WATTS (WITHOUT HEATER) OR 25 WATTS (WITH OPTIONAL HEATER) MAXIMUM POWER CONSUMPTION. AC POWER IS TO BE SHARED WITH TRANSIENT PRODUCING LOADS; USE AN INDIVIDUAL AC LIGHTING CIRCUIT. SUPPLY A SEPARATE EARTH GROUND. IF HEATER OPTION IS SELECTED, VOLTAGE INPUT MUST BE 115 VAC, ±10% AT 50 TO 60 Hz.
DC VOLTAGE INPUT IS 20-60 VDC (24 VDC ±10% FOR CE COMPLIANCE) (LESS THAN 100mV, 1-1000Hz RIPPLE), AT 10 VA MAXIMUM POWER CONSUMPTION. DC POWER IS POLARITY INDEPENDENT. POWER IS NOT TO BE SHARED WITH TRANSIENT PRODUCING LOADS. SUPPLY A SEPARATE EARTH GROUND. DC POWER ALLOWS USE OF SINGLE-CABLE 4 WIRE HOOKUP (2 WIRES FOR POWER, 2 FOR 4-20 mA). FOR INDOOR OR CONDUIT USE CABLE NUMBER (236906) (BELDEN NUMBER 9402 OR EQUIV.). FOR OUTDOOR USE IN CABLE TRAYS OR CL. 1 DIV. 2 HAZARDOUS AREAS USE CABLE NUMBER (236905) (BELDEN NUMBER 1048A OR EQUIV.).

2) MAXIMUM LENGTH OF SHIELDED 2 CONDUCTOR 18 AWG CABLE IS 1000 M (3280 FT). FOR INDOOR OR CONDUIT, USE CABLE NUMBER (202676) (BELDEN NUMBER 8760 OR EQUIVALENT). FOR OUTDOOR USE IN CABLE TRAYS OR CL. 1 DIV. 2 HAZARDOUS AREAS, USE CABLE NUMBER (202679) (BELDEN NUMBER 9341 OR EQUIVALENT). ALL WIRES SHOULD BE #18 AWG OR #20 AWG.

3) MEASURE SIGNAL IS 0 TO 100 KHz MAXIMUM, TRUE DIGITAL, AND SATISFIES RS-422 AND RS-423.
FOR SMART PRO CONNECT:
BLK WIRE TO TB 4 - 1
WHT WIRE TO TB 4 - 2
SHIELD WIRE TO TB 4 - 3
FOR PROPAC CONNECT:
BLK WIRE TO TB 1 - 4
WHT WIRE TO TB 1 - 5
SHIELD WIRE TO TB 1 - 12

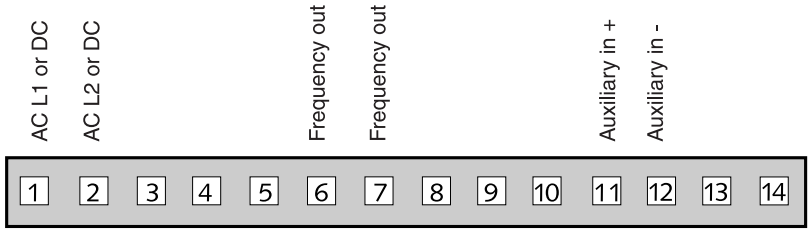


Figure 3: Interconnect

Terminal	Name	Description
1	L1	AC power input
2	L2	AC power input
3		Not used
4		Not used
5		Not used
6	Freq(+) output	Measurement signal output
7	Freq(-) output	Measurement signal output
8		Not used
9		Not used
10		Not used
11	Aux+	Auxiliary input frequency signal
12	Aux-	Auxiliary input frequency signal
13		Not used
14		Not used

Power

CAUTION!
DO NOT APPLY POWER until wiring is thoroughly checked!

The AC power source voltage input is 100-234 VAC at 50 to 60 Hz, at 15 VA maximum power consumption. AC power must not be shared with transient producing loads.

The DC power source voltage input is 20-60 VDC (less than 100 mV, 1-1000 Hz ripple) at 15 VA maximum power consumption. DC power cable can be part of a single cable 4-wire hookup, or can be separate from output the signal cable. (See "Output current loop" section.)

Switch for CE compliance

For CE compliance, install a power line switch no more than one meter from the operator control station

Conduit

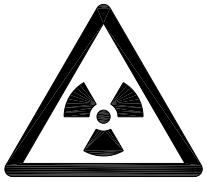
Conduit runs should be continuous and protection should be provided to prevent conduit condensed moisture from dripping into any of the housings or junction boxes. This may be done by using sealant in the conduit, or by arranging the runs so that they are below the entries to the housings and using "weep holes" where permitted.

A conduit seal-off must be used in the proximity of the housing (actual distance as required by local code) when the location is in a hazardous area.

If only one conduit hub is used, the other conduit hub must be plugged to prevent the entry of dirt and moisture.

Commissioning the gauge

Commissioning the gauge is the process of starting up the gauge, taking appropriate radiation field tests, checking the pre-programmed setup parameters, calibrating on process, and verifying the working of the gauge.



Typically, the gauge is commissioned by an Ohmart Field Service Engineer.

The source holder lock will be removed so that the gauge can take measurements in the field for the first time. Only persons specifically licensed by the U.S. NRC, Agreement State, (or other appropriate nuclear regulatory body) may remove the source holder lock.

> Note
> Users outside the U.S. must comply with the appropriate nuclear regulatory body regulations in matters pertaining to licensing and handling the equipment.

Can you remove the source holder lock?

If you are in doubt whether you are permitted to remove the source holder lock…Don't!

If this gauge is to be installed in the U.S. and you are specifically licensed to remove the source holder lock, you can get the combination from Ohmart Field Service Radiation Safety. Be sure your license specifically states that you are allowed to perform this operation.

If this gauge is to be installed in the U.S. and if it was sold under a U.S. general license, and you are not specifically licensed, you are not permitted to remove the source holder lock. (If you're not sure if the gauge is a general license gauge, check the source holder for the general license tag. If it is not there, it is not a general license device.) If the gauge is a general license device and you are not specifically licensed to remove the lock, an Ohmart Field Service Engineer or other specifically licensed person must remove it for you.

Field service commissioning call checklist

In many U.S. installations, an Ohmart Field Service Engineer will commission the gauge. To reduce service time and costs, use this checklist to ensure the gauge is ready to be commissioned before the Field Service Engineer arrives:

- ☑ Mount the source holder and detector per the certified drawings found in the custom information folder in this manual.
- ☑ Allow access for future maintenance.
- ☑ Make all wiring connections per the certified drawings and the "Wiring the equipment" section in this manual. Tie in the wiring from the Smart Pro analog output to the DCS/PLC/chart recorder.
  Ensure that the AC power to the detector and Smart Pro is a regulated transient-free power source. UPS type power is the best.
  Note the equipment warranty will be voided if the equipment is damaged due to incorrect wiring not checked by the Ohmart Field Service Engineer.
- ☑ Have process ready for calibration.
  When possible, it is best to be able to completely fill and empty the vessel, at the high and low levels for the initial calibration procedure, and when possible at 10% increments in between for the linearization procedure.
- ☑ ***Do not remove the lock on the source holder.*** Notify Ohmart Field Service if the lock has been damaged or if the lock is missing.

Chapter 3
Calibration

> Note
> This chapter discusses calibration with a Smart Pro or Smart Pro Pac. If your FiberFlex LFXG-F is used to output to a HART® level transmitter, refer to the HART® level manual for calibration instructions.

Calibration is done with the Smart Pro or Smart Pro Pac (the software in both operates identically.) Refer to the Smart Pro Reference for instructions to use the Smart Pro software. To perform the calibration, you must be familiar with the Smart Pro topics:

- Navigating through the Smart Pro screens
- Security access level
- Product Code
- Saving RAM to EEPROM permanent memory
- Accessing 520-level screens and changing item values

A summary of the calibration procedure for a standard level gauge is given here. More detail is presented in the Smart Pro Reference and the Smart Pro Mini Guide to Fast Startups.

> Smart Pro Note
> The instructions in this manual are compatible with Smart Pro firmware vx04.00 or later.

Initial process calibration with Smart Pro

Calibration establishes reference points, which relate the detector output to actual values of the process.

Initial calibration is required before the gauge can make measurements of any accuracy. Initial calibration must be performed after the gauge is installed and commissioned at the actual field site.

As long as certain critical process and equipment conditions remain the same (see "When a new initial calibration may be necessary" on page 26) the initial calibration procedures will not need to be repeated. The gauge will require only a periodic re-calibration (re-cal), which is a much simpler procedure.

Choosing the initial calibration method

For each installation, the user must choose one of two ways to calibrate the level detector. *The best calibration method depends on how the continuous level detector is to be used.* Read the following table to decide which method to use.

Calibration with a linearizer curve	Calibration with no linearizer curve
Use a linearizer curve if…the gauge is required to be repeatable and accurately indicate the level of process throughout the span.	Don't use a linearizer curve if…the gauge is only required to be repeatable, but need not accurately indicate the level of process.
Typically used for vessels in which it is critical to know the accurate level.	Typically used for surge bins or other vessels under control, in which one level is to be maintained.
The linearizer curve must be turned on, after collection of linearizer data and entering the curve in the Smart Pro (Screen 528 item 41 set to 1)	The linearizer curve must be turned off (Screen 528 item 41 set to 0)

Note
If you don't use a linearizer curve, the measurement indication will be repeatable but ***not accurate*** between the Cal Low Level and Cal High Level points. The measurement indication will also not be linear with respect to the actual process level. In some applications, accuracy is not critical and this method can be used.

If your application requires a linear or accurate indication of the actual process level, you must use a linearizer curve.

Smart Pro Note
Refer to the Smart Pro Mini Guide to Fast Startups for step-by-step calibration instructions. Also, Chapter 3 of the Smart Pro Reference provides detailed information on the calibration process. Be sure to follow the instructions for a level gauge as indicated on the flow chart in the beginning of the Mini Guide.

The span setting, data collection of high and low samples, and calculation of the two point calibration establish the "endpoints" of the calibration curve (level vs. raw counts on a graph). The calibration curve is non-linear, due to the measurement method of radiation transmission. The shape of the curve between the endpoints is determined by the linearizer.

Note
When performing calibration or any other procedure that affects the output of the gauge, be sure to disable the gauge from your distributed control system's automatic control.

Set process span

The Smart Pro (or Pro Pac) calculates the process span based on the lowest (Min Reading) and the highest level (Max Reading) the level detector is expected to measure. The low and high levels are entered in the Smart Pro *SETUP MENU 2 OF 4* under the *SET GAGE SPAN* screen.

The Min Reading and Max Reading must be set correctly before beginning the calibration procedures.

Cal Lo on Process

Setting the low level for calibration requires measurement with the level gauge of the empty vessel or lowest level. This sets the low end (sometimes referred to in the U.S. as "zero") of the calibration curve.

Before starting the cal low data collection:

- ☑ Empty the vessel
- ☑ Enter the password for Supervisor-level access on screen 052
- ☑ Verify on screen 502 that the Smart Pro is receiving the frequency input from the level detector, usually above 9000 counts for an empty vessel

Cal Lo on Process

1. Be certain the correct Product Code has been selected.
2. From the *MAIN MENU*, use the <Select> and <Enter> keys to progress through these screens:
   CALIBRATE SYSTEM
   CALIBRATE GAGE
   SELECT CHANNEL (CHOOSE CHANNEL #1)
   MORE CAL FUNCTIONS (3 TIMES)
   CAL LO ON PROCESS
3. On the *CAL LO ON PROCESS* , the detector will measure the sample, and the Smart Pro and will display "collecting data".
4. When prompted, enter the actual level
5. Save the results to the EEPROM.
   On screen 102 *RAM TO EEPROM* enter a 1 to upload to the EEPROM for permanent storage. (The "error code" on screen 102 should read 0, indicating the Smart Pro was successful in transferring the RAM data to the EEPROM.)

Procedure 1:Cal Lo on Process

Cal Hi on Process

Cal Hi on Process sets the "gain" of the calibration curve. Setting the high level for calibration can be simulated by shutting the source holder shutter. In some cases, simulating the high level may not be accurate, but you can adjust for it later when the tank is full. (See Procedure 5: Manually entering Cal Low and Cal High counts)

Before starting the cal high data collection:

- ☑ Turn the source holder shutter to the Off position
- ☑ Enter the password for Supervisor-level access on screen 052
- ☑ Verify on screen 502 that the Smart Pro is receiving the frequency input from the level detector. With a closed shutter, the counts should be close to zero.

Cal Hi on Process

1. Be certain the correct Product Code has been selected.
2. From the *MAIN MENU*, use the <Select> and <Enter> keys to progress through these screens:
   CALIBRATE SYSTEM
   CALIBRATE GAGE
   SELECT CHANNEL (CHOOSE CHANNEL #1)
   MORE CAL FUNCTIONS (1 TIME)
   CAL HI ON PROCESS
3. On the *CAL HI ON PROCESS* screen, press <Enter> to "Start data collect" The gauge will measure the sample and the Smart Pro will display "collecting data".
4. When prompted, enter the actual product level
5. Save the results to the EEPROM:
   On screen 102 *RAM TO EEPROM* enter a 1 to upload to the EEPROM for permanent storage. (The "error code" on screen 102 should read 0, indicating the Smart Pro was successful in transferring the RAM data to the EEPROM.)

Procedure 2: Cal Hi on Process

Calculate calibration with "Two Point Cal"

After the high and low density calibration data is collected, the Smart Pro can make the calibration gain calculation.

Two Point Cal

1. From the *CHANNEL #1* menu, move through:
   MORE CAL FUNCTIONS
   TWO POINT CAL
2. From the *TWO POINT CAL* prompt, select Yes.
   The Smart Pro will use the Cal Lo and Cal Hi datapoints to calculate the calibration.
3. Save the results to the EEPROM:
   On screen 102 *RAM TO EEPROM* enter a 1 to upload to the EEPROM for permanent storage. (The "error code" on screen 102 should read 0, indicating the Smart Pro was successful in transferring the RAM data to the EEPROM.)

Procedure 3: Calculating the calibration with "Two Point Cal"

Note
If you don't need a linearizer curve for the installation, the calibration is complete. You need not follow the next steps to create a linearizer curve.

Creating a linearizer curve (optional)

To decide if you need to create a linearizer curve for the installation, check the guidelines on page 18, "Choosing the initial calibration method."

To create a linearizer curve, you must take measurements with the gauge at intermediate levels between empty and full. You will record the sensor counts at each level, and call Ohmart with the data. Ohmart will calculate a linearizer curve and provide you with the data to enter into the Smart Pro.

Typical fill points are 25%, 50%, and 75%. The more points measured, the more accurate the linearization curve will be.

Collecting linearizer data

1. Fill the vessel to 25% or your first fill level. Be sure you know the level as accurately as possible.
2. Access screen 168 *DATA COLLECT* on the Smart Pro.
   Press <Enter> to begin the data collection. A countdown timer will begin.
3. When the countdown reaches zero, screen 168 will display the average counts for the data collection.
   Record the average counts and the actual level in a table. (See below.)
4. Repeat the procedure for each fill level, including full, or 100%

Procedure 4: Collecting linearizer data

Nominal level	Actual level	Average counts
25%		
50%		
75%		
100%		

Note
You may find that the counts for a full vessel are more than the counts using a closed shutter to simulate a full vessel. This means the shutter blocks more of the radiation than the process does. Or, when the vessel is full, some radiation beams over the process.
If this is the case, you can manually enter the counts for a full vessel in the Smart Pro memory and have it re-calculate the gain with the "Two point calibrate" function. See the procedure below.
You must know how to access the 520-level screens and change items.

Manually entering Cal High and Cal Low counts (***optional, see note above***)

1. Access screen 520.
2. At item 40, enter the counts that represent 100%.
3. If you need to change the empty counts, enter them at item 39.
4. Access screen 152 *CAL CHANNEL #1* and select Two Point Calibrate.
   On screen 155, select Yes to indicate you have done a cal low and cal high.
   On screen 157, select Yes to store the calibrate result in the EEPROM.
5. This causes the Smart Pro to calculate a new gain, based on the values you manually entered.

Procedure 5: Manually entering Cal Low and Cal High counts

Finally, the linearizer curve must be calculated and entered into the Smart Pro:

Entering and activating the linearizer curve

1. Call Ohmart Field Service (513-272-0131) or FAX Ohmart Field Service (513-272-4381) with the counts you obtained for the fill levels and recorded on the chart.
   Be sure to provide Ohmart a FAX number or e-mail address where you can receive linearizer curve data points.
2. Ohmart will use special software to calculate a linearizer curve from your data.
   They will FAX you 41 data point values for your linearizer curve, which you must enter into the Smart Pro.
3. Enter the 41 values on the Smart Pro screen 528, items 0 through 40. (Item 0 will always have a value of 0, and item 40 will always have a value of 10,000.)
4. Make the curve active by entering a value 1 at screen 528 item 41. At screen 528, use the Auto/Man button and Yes/No button to increment and decrement the item number.
   (If a 0 is entered at item 41, the Smart Pro will not use the curve you just entered.)
5. Save the results to the EEPROM:
   On screen 102 *RAM TO EEPROM* enter a 1 to upload to the EEPROM for permanent storage. (The "error code" on screen 102 should read 0, indicating the Smart Pro was successful in transferring the RAM data to the EEPROM.)

Procedure 6: Entering and activating the linearizer curve

When a new initial calibration may be necessary

Under most circumstances, the initial calibration procedure need not be repeated. The system will require only periodic re-cal to compensate for drifts over time. However, certain events will necessitate a new initial calibration. They are listed below:

- A new process application is being measured (contact Ohmart for recommendation)
- A new measurement span is required by the process
- A new measurement span setting has been entered into the software
- A new radiation source holder is installed
- The level detector is moved to another location (in U.S. only specifically licensed persons may relocate the gauge)
- Any change in the process vessel, for example lining, insulation, agitator
- Build up or erosion of vessel is excessive and cannot be compensated for with a re-cal

Periodic re-cal

Re-cal adjusts the system by resetting one point of the calibration curve to an independently measured or known level. Typically this is done on an empty vessel.

The frequency of re-cal depends on several factors, including the desired accuracy of the reading.

> Smart Pro Note
> The "Simple re-cal low" method is presented in this manual, because that is typically used for continuous level gauges.
>
> Refer to the Smart Pro Reference Chapter 3, section "Re-Cal / Channel #1 (Category II Functions)" for more information about choosing a method and performing the periodic re-cal.

Setup of the Simple Re-Cal Low establishes in the Smart Pro the default value of the level to be used for re-cals.

Setup of Simple Re-Cal Low

1. Know the value of the level (in engineering units) you will use for re-calibration, for example, 0%, 0 inches, 10 cm. This level must be used each time a Simple Re-Cal Low is done.
2. From the *MAIN MENU 1 OF 2*, use the <Select> and <Enter> keys to progress through these screens:
   CALIBRATE SYSTEM
   CALIBRATE GAGE
   SELECT CHANNEL (CHOOSE CHANNEL #1)
   MORE CAL FUNCTIONS (3 TIMES)
   ENTER ABSORBER VALUE
   LOW ABSORBER VALUE
3. On the *LOW ABSORBER* screen 147, enter the new value of the low level condition and press <Enter>
   The screen will prompt "Save?". Select Yes to save the new value.
4. The Smart Pro will automatically save the results to the EEPROM. When finished, it will display "Attempt completed"
   Select Done to finish.

Procedure 7: Setup for a Simple Re-Cal on Low

Simple Re-Cal Low

1. Be certain the correct Product Code has been selected.
2. From the *MAIN MENU*, use the <Select> and <Enter> keys to progress through these screens:
   CALIBRATE SYSTEM
   CALIBRATE GAGE
   SELECT CHANNEL (CHOOSE CHANNEL #1)
   SIMPLE RE-CAL LOW
3. On the *CAL START/STOP* screen, press <Enter> to "Start data collect" The gauge will measure the sample and the Smart Pro will display "collecting data".
4. On screen 145, the Smart Pro will display the counts for the data collect. It prompts "Save results?"
   Select Yes to save the re-cal results.
5. The Smart Pro will automatically save the results to the EEPROM. When finished, it will display "Attempt completed"
   Select Done to finish.

Procedure 8: Performing a Simple Re-Cal on Low

Chapter 4 Diagnostics and repair

Software diagnostics

Refer to the Smart Pro manual for software diagnostics information.

Hardware diagnostics

Two circuit boards in the LFXG-F are replaceable. They are identified below.

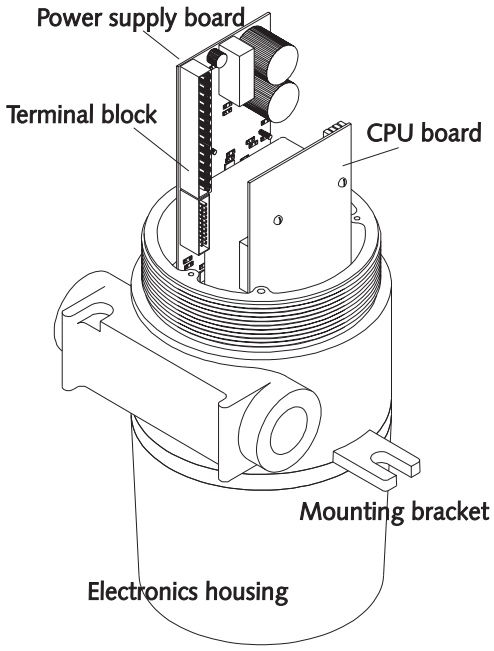


Figure 4: Circuit board identification

The following figure may be helpful in finding test points, fuses, jumpers and connectors on the CPU circuit board.

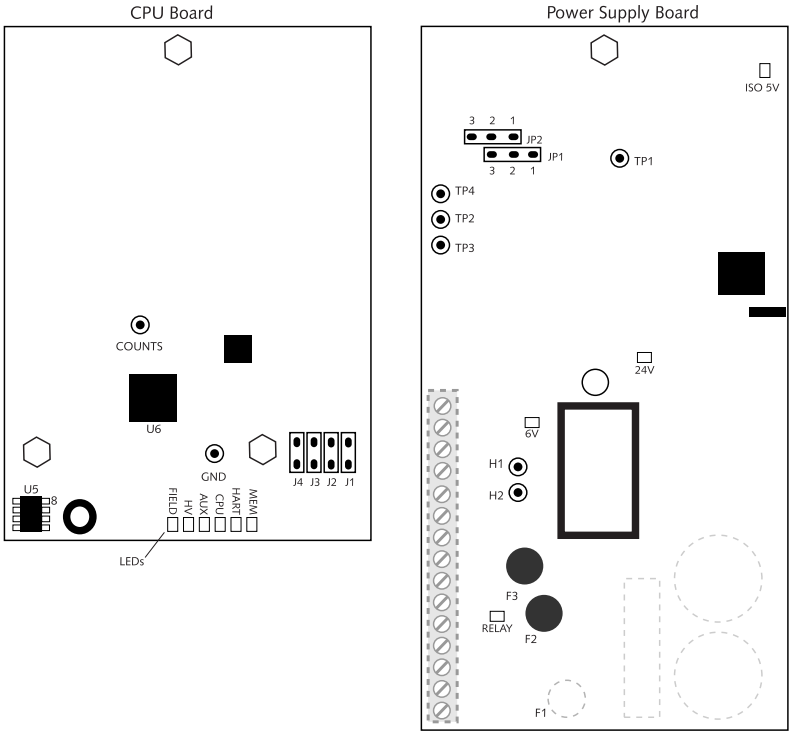


Figure 5: CPU board and power supply board simplified component layout

Test points

Test points are located on the Power Supply and CPU board.

Power Supply Test point label	Description
H1	Not used
H2	Not used
TP1	Isolated ground
TP2	Loop current test point 200mV/mA loop current. Referenced to isolated ground.

CPU Test point label	Description
Count	Raw input signal coming from preamp.
GND	Logic ground
U5 pin8	+5V power supply test points referenced to Logic ground.

Jumpers

Jumpers J1-J4 on the CPU board are used as divide by values for the output frequency to the Smart Pro.

> Note
> Do not change the jumper from the current setting without consulting Ohmart Field Service

J1	divide by 20
J2	divide by 10
J3	divide by 5
J4	divide by 2
none	divide by 1

If no jumper is installed, the divide by value is one – no change is made to the output frequency.

LED indicators

Basic functioning of the Ohmart electronics can be checked at the instrument with LED indicators on the CPU board. They are visible when the explosion proof housing cap is removed.

See the following table for a summary of the LED indications.

Figure 6: LED indicators

Power Supply Board LED summary table

LED	Description	Normal condition	Error condition	Recommendation
+6V	+6V DC voltage level to electronics	ON	OFF Electronics are not receiving +6V DC voltage required for functioning	Verify +5V on test points. Check fuse on Power Supply board. Check power input terminals 1, 2.
+24V	Not used			
Relay	Not used			

CPU Board LED summary table

LED	Description	Normal condition	Error condition	Recommendation
Mem	Not used			
HART	Not used	ON	n/a	
CPU	Central processing unit on CPU board "heartbeat"	Blinks at rate of 1 time per second	LED doesn't blink. CPU not functioning.	Check power input. Replace CPU board.
Aux	Auxiliary input frequency signal indicator	Blinks if auxiliary input present. OFF if no auxiliary input present	None	Check auxiliary input wiring terminals 11 and 12 with a meter for frequency signal. Check auxiliary input equipment.
HV	Not used			
Field	Radiation field indicator	Cycles in proportion to radiation field intensity at detector. ON for 10 seconds for each mR/hr, then off for 2 seconds. (Can use LED 5 which blinks 1 time/sec to time LED 9 for field indicator.)	None	A 1 mR/hr (2580nC/kg/hr) field is usually required for a measurement. Check for closed source shutter, buildup, insulation.

Maintenance and repair

Periodic maintenance schedule

Since the Ohmart LFXG-F contains no moving parts, very little periodic maintenance is required. We suggest the following schedule to prevent problems and to comply with radiation regulations:

Description	Frequency	Procedure
Re-cal	As required by process conditions, usually at least once a month	Calibration chapter
Source holder shutter check	Every 6 months unless otherwise required by applicable nuclear regulatory agency	Radiation safety instructions (shipped separately with source holder and in the folder of this manual)
Source wipe	Every 3 years unless otherwise required by applicable nuclear regulatory agency	Radiation safety instructions (shipped separately with source holder and in the folder of this manual)

Spare parts

Spare parts are available directly from Ohmart Parts and Repairs Department for U.S. and Canada installations. Installations in other countries may have spare parts purchased through their local Ohmart representative.

Description	Ohmart part number
power supply board	239747
CPU board	421110
125 mA fuse on power supply	238661
2A fuse on power supply	240539

Replacing the CPU or Power Supply board

Very few parts are field repairable, but the circuit boards can be replaced. Use great care to prevent damaging the electrical components of the gauge; we recommend appropriate electrostatic discharge procedures.

Replacing a circuit board may be required if one of its components becomes damaged. Before replacing a board, check the troubleshooting flowcharts or call Ohmart Field Service to be sure a replacement is necessary.

Replacing the CPU or Power Supply board

1. Turn off power to the unit.
2. Remove the housing cover.
3. Remove the plastic electronics cover.
4. Remove the terminal wiring connector.
5. Remove the screws from the top hold down plate.
6. Carefully pull the two boards (still attached to their mounting bracket) out of the housing. Be careful as you pull the CPU board out so that the ribbon cable that attaches to the sensor does not get damaged.
7. Once the boards are out, remove the cable between the CPU and Power Supply boards.
8. Remove the appropriate board from its mounting bracket and replace it with a new board. If the CPU board is being changed, you must disconnect the sensor connector from the CPU board. When the new CPU board is installed, reconnect the sensor connector.
9. Reconnect the cable between the CPU and Power Supply boards.
10. Carefully place the circuit boards back into the housing. Again, be careful with the sensor cable on the CPU board. Make sure this cable does not become damaged when reinstalling the boards.
11. Secure the brackets back to the hold down plate.
12. Reconnect the terminal wiring connector.
13. Install the plastic electronics cover.
14. Put the housing cover back on.

Procedure 9: Replacing the CPU or Power Supply board

Requesting field service

To request field service within the U.S. and Canada, call 513-272-0131 from 8:00 a.m. to 5:00 p.m. Monday through Friday. For emergency service after hours, call 513-272-0131 and follow the voice mail instructions.

Returning equipment for repair to Ohmart

When calling Ohmart to arrange repair service, be ready with the following information:

- ☑ Product model that is being returned for repair
- ☑ Description of the problem
- ☑ Ohmart Customer Order (C.O.) Number
- ☑ Purchase order number for the repair service
- ☑ Shipping address
- ☑ Billing address
- ☑ Date needed
- ☑ Method of shipment
- ☑ Tax information

Returning equipment for repair

1. Call Ohmart Nuclear Products Repair: 513-272-0131
   8:00 a.m. to 5:00 p.m. Eastern U.S. time, Monday through Friday
2. Ohmart will assign the job a material return authorization (MRA) number.
   Please note: Ohmart reserves the right to refuse any shipment that has not been assigned an MRA.
3. Indicate the MRA on the repair service purchase order.
4. ***Clearly*** mark the shipping package with the MRA number.
5. Send the confirming purchase order and the equipment to:
   Ohmart Corporation
   Attention: Repair Department
   4241 Allendorf Drive
   Cincinnati, OH 45209-1599 USA

Procedure 10: Returning equipment for repair

Note
You must first contact Ohmart and receive a material return authorization number (MRA) before returning ***any*** equipment to Ohmart. Ohmart reserves the right to refuse any shipment not marked with the MRA number.

Notes

Appendix I
Special applications

This chapter provides application specific information for special installations:

Multiple detectors summation page 38

Vapor pressure compensation with Smart Pro Electronics page 41

Internal heater kit for applications below –50C page 45

If your application is not listed here, you may have been provided application specific information on the certified drawings. The certified drawings are in the special information pocket in this manual. If you have other application questions, contact Ohmart Field Service in the U.S. or Canada at 513-272-0131 or your local rep outside of the U.S. or Canada.

Multiple detectors summation

Some applications require a measurement length longer than the maximum level detector length.

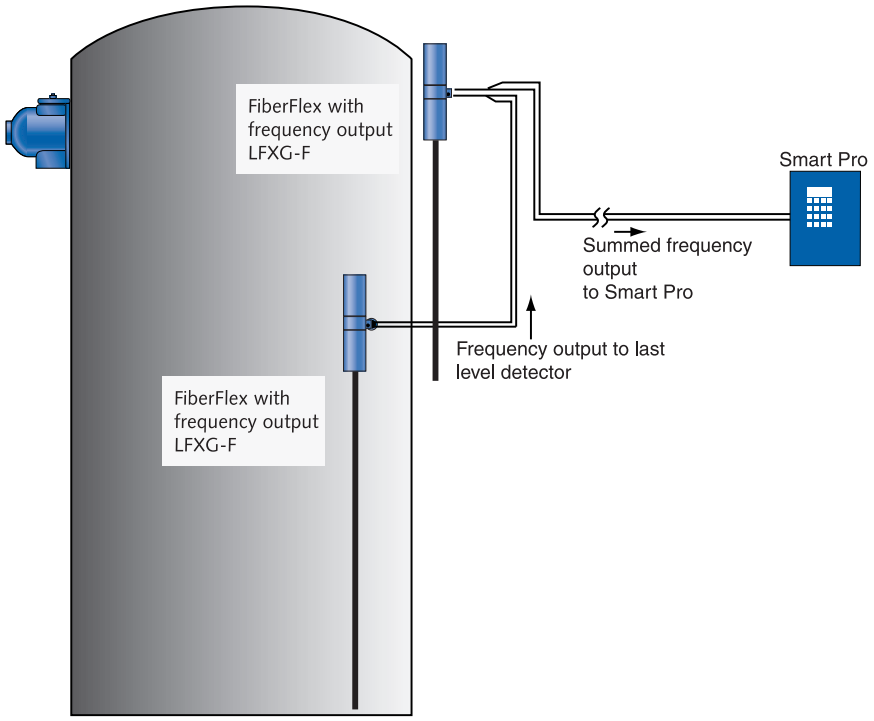


Figure 7: Multiple detectors summation

Special drawings from Ohmart

Applications requiring multiple detectors summation are identified at the time of order. The end user, engineering contractor (or both) will have received certified drawings for the exact equipment ordered. Refer to the drawings along with this section of the manual.

> Note
> If the instructions on the drawings and this manual differ, follow the drawing instructions. They will be specific to your order.

Installation requirements

A multiple detector application consists of at least one detector that is capable of summing an input frequency (e.g. model FiberFlex™ LFXG-F, or an LSF, LJF, or LNF). Follow these installation guidelines:

- Install the summing detector at the top of the measurement range.
- Offset the detectors vertically so that the end of the top detector's active length corresponds to the beginning of the bottom detector's active length.
- All detectors should be placed in the radiation beam.

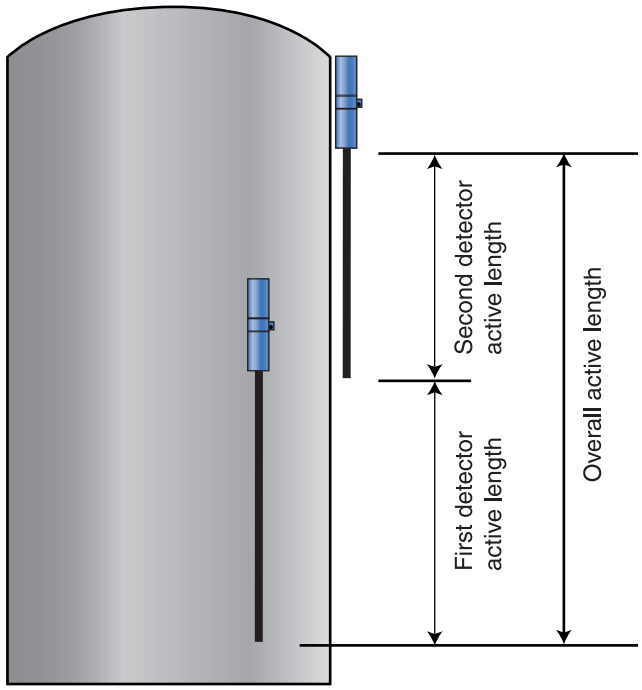


Figure 8: Placement of multiple detectors

Detector wiring

Multiple-detector applications require at least two frequency output detectors electrically linked in a chain. Only the last detector in the chain sends an output to the Smart Pro. The LFXG-F automatically sums the frequency input (auxiliary input, pins 11/12) with the frequency it generates in response to radiation. The summed frequency is output at pins 6/7. When no input is present at pins 11/12, the output is only the detector's response to the radiation.

Jumpers to reduce counts

The Smart Pro cannot accept more than 32767 counts per second. If the total counts exceeds this, a jumper can be set on the last detector in the chain to divide the output to the Smart Pro.

This must be set before calibrating. Verify the frequency is under 32767 with a meter at the Smart Pro input terminal on empty vessel condition. If the frequency exceeds 32767, adjust the jumper on the last detector as required, according to the table, below.

J1	divides counts by 20
J2	divides counts by 10
J3	divides counts by 5
J4	divides counts by 2

Initial settings and calibration requirements

No special Smart Pro software initial settings or calibration methods are required. The detectors automatically sum the frequencies, so the use of multiple detectors is transparent to the Smart Pro.

When setting the span settings and calibrating, use the levels for the entire measurement span, as if one long detector was installed.

Vapor pressure compensation with Smart Pro Electronics

Some applications with fluctuating vapor pressure require compensation of the level indication. Due to the nature of measurement with radiation transmission, an increase in vapor pressure causes a false higher indication, and a decrease in vapor pressure causes a false lower indication.

Compensation is made with a density measurement of the vapor space with an Ohmart nuclear density gauge. It monitors the vapor space density, and sends its frequency output to the Smart Pro channel 2. The level measurement is input to Smart Pro channel 1, as usual. Special firmware enables the vapor density effect to be eliminated in the final level indication.

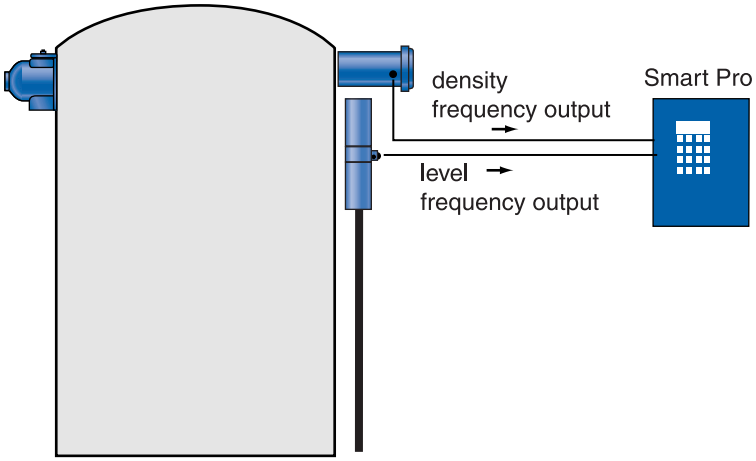


Figure 9: Vapor compensation system

Installation requirements

The level detector is mounted as usual. The density gauge must be mounted so that it is in the radiation beam, but is above the highest expected level. This ensures that the only process condition affecting the density gauge is the gaseous pressure change in the vessel.

The pressure compensation algorithm in special Smart Pro firmware makes use of the change in vapor pressure to determine the amount of compensation needed to correct the level indication.

Detector wiring

The level detector frequency output is wired into the Smart Pro TB4, pins 1&2. The density gauge output is wired into Smart Pro TB4, pins 5&6.

Initial settings and calibration requirements

> Note
> Setting up a pressure-compensated level gauge system involves many application-specific considerations. *Ohmart Field Service should be on-site to set up the system.*

To set up a system with vapor pressure compensation, follow these general guidelines with the assistance of Ohmart Field Service:

1. At the Ohmart factory, the density gauge output channel will be set up to point to the temperature compensated raw counts location.
2. Set up and calibrate the level gauge as usual. See the Calibration chapter of this manual for instructions.
3. After the level gauge is calibrated, establish a known, minimum pressure in the vessel.
4. At the Smart Pro, access screen 521, item 14. This displays the counts from the density detector when the pressure is at a minimum. Make note of the counts.
5. Access screen 529, item 109. Copy the counts value from the above step to item 109. This sets up the reference counts of the density detector.
6. Access screen 529, item 110. Enter an initial gain term value at this address. Initially, enter the value 1800 (which is a gain of 1.8). You may need to adjust this value later to fine tune the system.
7. Access screen 529, item 120. Enter a value of 1 at this address to enable the pressure compensation feature. (A value of 0 disables the pressure compensation.)

Pressure compensation is now set up, but it must be fine tuned to work properly.

Pressure compensation fine tuning

Since variables such as the vessel geometry, process material characteristics, and pressure change ranges affect the output, it is difficult to accurately predict the gain term needed for an individual installation. Fine tuning the system requires maintaining a known

level of process material, and changing the gaseous vapor pressure. By observing how the system reacts, you will adjust the gain term value on Smart Pro screen 529 item 110. Follow the general guidelines below:

1. In the vessel, establish a known, repeatable minimum pressure.
2. Establish a process level of approximately 30% to 60%. Make note of the initial level indication, as displayed on the Smart Pro operator screen.
3. Increase and maintain pressure to some value near the maximum pressure likely to be present inside the vessel. Do not adjust the process level in the vessel.
4. Allow time for the level measurement to stabilize.
5. Compare the level measurement at maximum pressure to the measurement at minimum pressure.
   - If the level indication at maximum pressure is *less* than at minimum pressure, then the gain term is too large. Reduce the gain term (screen 529, item 110) in increments of 100 until the level indication is the same as it was at minimum pressure. With each change to the gain term, be sure to allow time for the level measurement to stabilize.
   - If the level indication at maximum pressure is *greater* than at minimum pressure, then the gain term is too small. Increase the gain term (screen 529, item 110) in increments of 100 until the level indication is the same as it was at minimum pressure. With each change to the gain term, be sure to allow time for the level measurement to stabilize.
6. When the gain term is set at a satisfactory value, do an upload to the EEPROM to save the settings permanently.
7. If you need to disable the pressure compensation, access screen 529, item 120. Enter a value of 0 at this address. (A value of 1 enables the pressure compensation.)

Smart Pro memory locations for pressure compensation

The following memory locations are used by the Smart Pro in vessel pressure compensation applications (only with the special firmware):

Description	Smart Pro memory location
Compensated raw counts	Screen 520, item 7
Raw counts	Screen 520, item 6
Density gauge counts	Screen 521, item 14
Gain (entered by user)	Screen 529, item 110
Reference density counts	Screen 529, item 109
Enable (1) / Disable (0) pressure compensation	Screen 529, item 120

Internal heater kit for applications below -50˚C

A heater kit option is available for applications that require a -50˚C (-58˚F) temperature rating. With the heater option, the internal temperature of the unit rises approximately 20˚C (68˚F) degrees.

The heater kit does not affect the functionality of the level detector in any way; no special firmware is required.

Heater kit power	Ohmart Part Number
115 VAC	240723
220 VAC	240724

Changes to specifications

If the heater kit is installed, the power rating changes from the specifications on page 3 of this manual.

With the heater installed, the maximum power consumption increases to 25 watts.

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